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EC02-152 Value of Potatoes for Feeding Livestock

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Potatoes are relatively high in feed value and can be used as an energy source for livestock. The protein found in potatoes is relatively easy to digest and utilize. On a per land unit or per growing time unit, potatoes produce more energy and protein than any other crop. The potato markets demand a high quality potato, based on such tuber characteristics as starch and sugar content, size and shape, and blemishes and defects. These characteristics may not have a major effect on nutrition or edibility; however, many tubers may not meet consumer preferences and may be diverted to livestock feed, especially in years of over-production. The purpose of this publication is to evaluate potato's value as a feed for cattle, sheep and hogs, and to describe advantages and potential problems.

Figure 1. Cattle feeding on potatoes, a nutrient-dense crop and excellent source of carbohydrates, digestible proteins and essential amino acids.

Potato Nutrition

In North America, most potatoes are white-fleshed, meaning the core (inside, meat) is white. These are referred to as Irish white potatoes. They also may be referred to as red, russet (tan to brown with a rough textured skin) or white (cream to light tan with a smooth textured skin), based on their skin color. These three types of potato differ in their dry matter (DM) content: reds, used for salads, will have as low as 15 percent dry matter (specific gravity = 1.055) while round whites, used for chips, will have as high as a 25 percent dry matter content (specific gravity = 1.103). For the purposes of comparative calculations, we will model after a typical russet-type baking potato with a dry matter content of 20 percent and a specific gravity of 1.079.

Potatoes are a nutrient-dense crop and an excellent source of carbohydrates, digestible proteins and essential amino acids *(Table I)*. Potatoes are high in potassium but relatively low in calcium and phosphorus. They are an excellent source of vitamin C and B-complex but are low in vitamins A and D.

Table I. Nutrient composition of potatoes (National Research Council, 1984).

	Percent of Dry Matter	*Amount in 100 lbs of Potatoes*
Water	0.0	80.0 lb
Dry Matter	100.0	20.0 lb
Total Digestible Nutrients (TDN)	81.0	16.2 lb
Crude Protein	9.5	30.4 oz
Crude Fiber	2.4	12.8 oz
Fat	0.4	1.6 oz
Minerals:		
Calcium	0.04	0.13 oz
Phosphorus	0.28	0.90 oz
Potassium	2.17	6.94 oz
Magnesium	0.14	0.45 oz
Sodium	0.09	0.29 oz
Copper	0.003	0.01 oz
Iron	0.008	0.02 oz
Manganese	0.004	0.03 oz

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Table II. Nutrient value of potatoes compared to other feedstuffs (Rust et al., 1997; USDA, 1984).

	Potato	*Corn*	*Corn Silage*	*Alfalfa*
Dry Matter (DM)%	*20*	*85*	*35*	*90*
	Dry Matter Basis			
Cattle:				
NEm, Mcal/cwt*	0.89	1.02	0.74	0.56
NEg, Mcal/cwt	0.60	0.70	0.47	0.31
TDN, %	82	90	70	58
DM Energy Equiv	0.164	0.765	0.245	0.522
Sheep:				
TDN, %	86	97		
DM Energy Equiv	0.172	0.825		
Swine: (cooked potatoes)				
TDN, %	88	91		
DM Energy Equiv	0.176	0.774		

* cwt = hundred-weight or 100 pounds potato tubers.

Based on percent dry matter, potatoes, when compared to other feeds, have as much crude protein as corn, slightly more than corn silage and about 60 percent that of alfalfa *(Table II)*. Potatoes are low in calcium, requiring that calcium be supplemented if potatoes comprise a significant portion of livestock rations. The phosphorus content of potatoes is about the same as corn, corn silage and alfalfa. Potassium on a dry weight basis is as high as alfalfa, double that of corn silage and over five times that of corn. In general, potatoes are considered somewhat similar to corn in feeding considerations.

Nutritional Value of Potato for Livestock

Nutritional value of feeds depends greatly on their energy level which is often measured as total digestible nutrients (TDN) on a percent dry matter basis. By this comparison, potatoes provide slightly less than shelled corn and more than corn silage and alfalfa *(Table II)*. Because of the high moisture content, potatoes have 20 percent to 25 percent of the TDN of shelled corn on an as-fed basis.

Dry matter energy equivalents may be used to compare feeds for specific livestock. They are calculated by multiplying the percent dry matter (DM) by the percent of total digestible nutrients (TDN). Dividing this equivalent for potatoes by that of a feed, you can estimate how many pounds of feed will equal the energy value (TDN) of 100 pounds of raw potatoes. Using this calculation for cattle, 100 pounds of raw potatoes equals 21 pounds of corn, 67 pounds of corn silage and 31 pounds of alfalfa. For sheep, 100 pounds of raw potatoes equals 21 pounds of corn. For swine, 100 pounds of raw potatoes before cooking equals 23 pounds of corn.

Another method to evaluate a comparison based on energy is to compare TDN on a dry weight basis (percent TDN of one feed ingredient/percent TDN of another). Using this method for cattle, potatoes have 91 percent of the value of corn (percent TDN potato divided by percent TDN corn) on a dry weight basis. For sheep and swine, potatoes have 89 percent and 97 percent of the value of corn, respectively.

The dry matter content of corn is about 4.25 times that of potatoes on a per unit weight basis. It takes 400-450 pounds of potatoes to equal 100 pounds of corn on an energy basis.

Cattle Feeding

Potatoes are high in rapidly digestible starch (70 percent of the dry matter); cattle should be gradually introduced to a potato diet *(Figure 1)*. Free-choice feeding is not recommended. Potatoes should be introduced into their ration with increasing amounts over a two- to three-week period. Start at 3-4 pounds per day, and gradually increase to 10-15 pounds per day for calves, 25 pounds per day for yearlings, and 35-40 pounds per day for 1100-pound cows (Lambert, 1957). Up to half of cattle's dry matter ration may be potatoes. Since cooked potatoes may be less palatable to cattle, they should be processed raw. In research by Wilson (1950), daily intake of potatoes by cattle was 50 to 75 pounds per head when mixed with straw and a protein supplement. Daily weight gain was equivalent to a chopped alfalfa-ground ear corn mix.

Adding potato to a ration may lower the cost per pound gained, depending on the relative costs of potatoes delivered to the bunk versus other available feeds. Costs of storing and processing potatoes also need to be considered.

One method of pricing potatoes is on an energy dry matter basis. For example:

corn @ $71.40/ton ($2/bu) divided by 0.85 (part DM) = $84/ton DM

potato @ $15/ton ($0.75/cwt) divided by 0.2 (part DM) = $75/ton DM.

A final decision on whether to feed potatoes should be based on the cost per unit of energy. Multiply the cost of the corn ($84/ton dry matter) by the ratio of NEg of potato to corn (60/70, *Table II*) equals $72/ton potato dry matter. Multiplying this value times the dry matter in potatoes (20 percent) shows potatoes are worth $14.40 per ton compared to corn at $2 per bushel. In other words, on an energy basis without factoring in shipping and processing, potatoes at $0.72 per hundredweight are equivalent to corn at $2 per bushel.

Sheep Feeding

For finishing lambs, use one to two pounds potatoes per day with alfalfa hay and grain; for ewes up to lambing, use 2-2.5 pounds per day with alfalfa hay increasing to 4 pounds per day after lambing (Lambert, 1957). Cooking potatoes for feed does not add value and may reduce palatability. Because potatoes are very palatable, lambs may overeat, potentially causing acidosis. This can result in lambs going off feed or possibly dying. Therefore, potatoes should be introduced gradually to diets.

Swine Feeding

Because swine are single-stomach animals, potatoes should be cooked or dried before feeding. (Potatoes also should be cooked before feeding to poultry.) One cooking tip is to lay steam pipes on the floor of a dump truck, load with potatoes, cover with a tarp, and connect pipes to a steam outlet for 30 min (Wilson, 1950). Raw potatoes have one-half to two-thirds the value of boiled potatoes for swine. One hundred pounds of potatoes replaces about thirty pounds of mixed grain.

Horse Feeding

Caution should be taken in feeding potatoes to horses. Three to five pounds per day may be acceptable.

Processing Potatoes for Feed

For rumen animals such as cattle and sheep, use raw potatoes. One of the most successful methods of storing and feeding potatoes is to ensile them with a roughage source such as ground alfalfa or other hays. Choking has not been reported as a problem when potatoes are packed into bunker silos and allowed to ferment for two or more weeks. For desirable fermentation, the dry matter of the feeds in the silo should be 35-45 percent. Since potatoes are high in moisture, for proper fermentation add dried feeds to lower the dry matter level of the silo pack. Success has been reported with mixes of 400-500 pounds of dry hay and a ton of potatoes. The resulting mix will contain 33-38 percent dry matter. Dan Hinman of the University of Idaho suggests a blend of 80 percent potatoes, 16 percent dry ground hay (300 to 350 pounds per ton of potatoes), and 4 percent ground grain (80 pounds). The dry hay will soak up any excess moisture in the potatoes.

Figure 2. Potatoes are ground for livestock feed and then emptied into a waiting truck.

Figure 3. Ground potatoes ready to be mixed and ensiled, depending on the final feed needed.

When this mix is ensiled, it will have about the same nutrient content as corn silage. Analysis of the mixture after ensiling would indicate how to use it most effectively in a total ration. Dry freezing will absorb most of the excess moisture in raw potatoes. For open-air drying by freezing, spread potatoes two to three inches deep in a field or pasture (Wilson, 1950). Potato tubers will shrivel to hard little lumps and keep indefinitely. Cattle readily eat them in the summer. To sun dry raw potatoes, chop tubers into one inch chunks or strips, spread in a thin layer and pick them up when dry.

Due to rapid fermentation in the rumen, higher levels of fiber in the diet may be advisable if high levels of potatoes are fed to ruminant animals. It is important that potatoes be introduced to ruminants

gradually. Initially no more than eight pounds per head should be fed in a mixed ration and then increased only in four- to five-pound increments every other day until the desired level is reached. After the bacteria in the rumen have adapted to potato starch in the diet, the animals should be fed at a constant level (Aldrich, 1979). If potatoes are not fed for four to five days, they should be gradually reintroduced.

Potatoes should be cooked for monogastric animals such as swine.

Supplements for Cattle and Sheep

Supplements designed for corn diets may be used for diets containing potatoes. If high levels of potatoes are fed in moderate roughage diets, calcium may need to be supplemented. The most economic source of calcium would be calcium carbonate or feed-grade limestone. When phosphorus exceeds calcium in the diet, urinary calculi (water belly) may be a problem.

Feeding 60-70 pounds of potatoes provides less than half the daily protein requirement for cattle; therefore, one pound of a protein supplement containing 40-50 percent crude protein or three pounds of alfalfa needs to be added. Also, since potatoes are low in fiber, hay should be added for a source of roughage. Alfalfa hay would also be an excellent complimentary source of minerals, especially calcium. A suggested supplement for rations with high amounts of potatoes might contain

Table III. Example of Rations for Cattle

Ingredient	*Dry Pregnant Cow, Last Trimester*	*Lactating Cow*	*Backgrounding approx. 2.5 ADG*[1]	*Wintering Calf, approx. 2.0 ADG*[2]
	lb/head/day			
Grass Hay	7	7	10	—
Alfalfa Hay	5	7	17	15
Potatoes	45	55	17	17
Total	57	69	44	32
Approximate Nutrient Composition:				
Dry Matter, %	34	34	60.5	50
Crude Protein, %	10.7	11.1	14.3	16.0
NEm, Mcal/lb	—	—	98	68
NEg, Mcal/lb	—	—	48	38.5
TDN, %	69.6	70	—	—
Calcium, %	0.45	0.49	0.79	1.1
Phosphorus, %	0.23	0.23	0.26	0.25

[1]700-950 lb steer.
[2]555-750 lb steer.

Table IV. Example of Rations for Sheep

Ingredient	*Pregnant Ewe*	*Lactating Ewe*	*Finishing Lamb*
	lb/head/day		
Corn or Barley	—	0.5-1	1
Alfalfa Hay	4-6	3-4	2-2.5
Potatoes	2	2-4	1-2
Total	6-8	5.5-9	4-5.5
Approximate Nutrient Composition:			
Dry Matter, %	65.3-71	63-57.4	66
Crude Protein, %	17.2	15.7	15.0
TDN, %	62	67	70
Calcium, %	1.3	1.0	0.90
Phosphorus, %	0.25	0.26	0.26

Cautions

1. **Choking (cattle):** Whole, small potato tubers can cause choking when consumed whole.

   Solutions: Crush, slice or preferably chop the potato tubers. If tub grinders are used, add small amounts of hay or straw to avoid clogging. Rocks and hard soil clumps may be a problem when processing potatoes. Some cattle producers report good results by using old silage cutters or snow blowers. Crushing may be accomplished by spreading potato tubers on a concrete slab and driving over them with heavy farm machinery. Allowing potatoes to freeze and thaw will cause softening and shrinking, thereby lessening the danger. Freezing and thawing throughout the winter can replace crushing or discing potatoes. Choking does not seem to be a problem when feeding potatoes to sheep.

2. **Greening:** Sun-greened and light-sprouted potato tubers produce a glycoalkaloid called 'solanine' that can cause sickness and death. Symptoms of solanine poisoning are staring eyes, dilated pupils, staggering, and weakness. High exposure can lead to death and may cause the termination of pregnancy in cows.

   Solutions: Ensiling eliminates the problem. Allowing tubers before turning green to freeze and thaw during winter storage will eliminate the problem; however, some spoilage could occur. Mixing potatoes with straw will limit light exposure, disrupt greening and keep potatoes dry. Mechanically de-sprouting tubers eliminates the solanine source. ***Note:*** Cattle getting into potato fields with vines may be exposed to solanine by feeding on the potato berries and vines. They also may be poisoned by nightshade, which contains a more poisonous glycoalkaloid, growing in the potato field. Cattle should not graze in a potato field until the vines are removed and unless potato tubers are not exposed to light.

3. **Overfeeding or Acidosis Disorders:** Raw potatoes ferment in the rumen very rapidly. When raw potatoes are fed in excess of half of the ration dry matter, acidosis may be a problem, especially if introduced too rapidly in the ration.

   Solutions: Limit potatoes to less than 50 percent of the ration dry matter and introduce the ration gradually.

4. **Palatability (sheep):** Sheep may not find potatoes palatable at first.

   Solution: Gradually introduce potatoes into the feed until two pounds per day is reached. ***Note:*** Some sheep develop a strong appetite for potatoes and may overeat, risking acidosis.

5. **Diseases or pesticide residues.**

   a. No potato diseases or rot affect livestock.

   b. Pesticide residues are not a problem with potatoes.

6. **Problems for potato grower:** Potato piles may be sources for late blight and potato viruses that might infect the following year's potato crop.

   Solutions: Plant the next year's potato field as far away as possible from the old potato piles being used for livestock. Keep an eye on sprouting in the pile since the sprouts carry the pathogen. Encourage the destruction of the pile by chopping, crushing, freezing/thawing, and/or ensiling.

molasses, urea, limestone, dicalcium phosphate, magnesium oxide, vitamins A, D and E, and/or a trace mineral pre-mix containing manganese, iron, zinc, copper, iodine, and cobalt. Ration guides are given for cattle in *Table III* and for sheep in *Table IV*. Protein supplement requirements decrease with better hay quality.

Note: A nutritionist can calculate specific rations based on ingredient analysis and livestock requirements.

Potato Waste

Feeding livestock potato waste is done in states with potato processing plants specifically for French fries, potato chips or other processed products. The most common form is called 'filter cakes', which contain fine particles of potatoes that have gone through a vacuum drum filter. Other waste forms are 'steam peeling waste,' 'screening waste' and 'dried potato products.' For information, see Hinman and Sauter (1978), Sauter *et al.* (1980) and Stanhope *et al.* (1980).

References:

Aldrich, S. 1979. Potatoes (D.M.) compare with corn. Feedlot management Feb:52.

Hinman, D.D. and E.A. Sauter. 1978. Handling potato waste for beef cattle feeding. University of Idaho CIS No. 425.

Lambert, W.V. 1957. Potatoes for livestock. University of Nebraska Cooperative EC244.

National Research Council. 1984. Nutrient requirements of beef cattle. 6th Edition. National Academy Press.

Pavlista, A.D. 1997. Potato types: their characteristics and uses. American Biology Teacher 59:26-29.

Pavlista, A.D. 2001. Green potatoes: the problem and the solution. University of Nebraska Cooperative Extension EC1437.

Rust, S.R., D.B. Buskirk and H.D. Ritchie. 1997. Feeding whole potatoes to beef cattle. Michigan State University, Animal Science Mineo No. 365.

Sauter, E.A., D.D. Hinman, R.C. Bull, A.D. Howes, J.F. Parkinson, and D.L Stanhope. 1980. Studies on the utilization of potato processing waste for cattle feed. University of Idaho Research Bulletin No. 112.

Stanhope, D.L., D.D. Hinman, D.O. Everson, and R.C. Bull. 1980. Digestibility of potato processing residue in beef cattle finishing diets. Journal of Animal Science 51:202-206.

Wilson, J. 1950. How to feed those low-grade spuds. Root Crops 5:37.